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Assessing the potential value of FORCEnet technologies within the JFMCC planning process using the knowledge value added methodology

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THESIS

ASSESSING THE POTENTIAL VALUE OF FORCENET TECHNOLOGIES WITHIN THE JFMCC PLANNING PROCESS USING THE KNOWLEDGE VALUE ADDED METHODOLOGY

by

Keith E. Kovats

June 2006

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13. ABSTRACT (maximum 200 words)

In the FORCEnet Functional Concept document published by the Chief of Naval Operations and the Commandant of the Marine Corps, the leaders of the US Naval Forces called for the development of "adaptive, distributed networks of commanders, staffs, operating units, supporting organizations, sensors, weapons and other equipment interacting with one another on an underlying infrastructure, as well as the associated command and control policies, concepts, organizations… to allow them to interact." Posed to invest in the development of the FORCEnet architecture, the Navy and Marine Corps require a means of analysis to determine the value of information technologies prior to development and acquisition. The Knowledge Value Added (KVA) methodology can provide the decision makers with quantitative tools to make informed and accurate decisions in the acquisitions process of information technologies within the FORCEnet Functional Concept framework. Historically, these decisions were based on costs, schedule, and capabilities, with the emphasis on cost.

A Proof of Concept analyzing the Joint Forces Maritime Component Command Planning Process was developed to demonstrate the utility of the KVA method. This analysis demonstrates the current inefficiencies within the process and the potential value of notional information technologies that could be developed to support the planning process.

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ASSESSING THE POTENTIAL VALUE OF FORCENET TECHNOLOGIES WITHIN THE JFMCC PLANNING PROCESS USING THE KNOWLEDGE VALUE ADDED METHODOLOGY

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requirements for the degree of

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Finally, to my wife and best friend, Amy, I offer my deepest love and gratitude. Through her continuous support, understanding, and encouragement in this endeavor and in all other aspects of our lives I find the true value in all things.

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I. INTRODUCTION

A. BACKGROUND

The Department of Defense, along with all other government agencies, operates in an environment of competition for limited funding resources. In this environment, the military services must concurrently prosecute the missions assigned for the defense of the nation and its interests, while looking toward the future to develop the systems that will be applied to the nation's defense in the years to come. Through decisions made today, the systems that support the nations forces will be conceptualized, developed, and deployed to meet the future threats to our nation. To continue to thrive in this environment of limited budgets, the United States Navy must determine the future capabilities of the force and be able to soundly present the reasoning objectively to decision makers in the Department of Defense and Congress.

It is estimated by experts at the Government Electronics and Information Technology Association that the Department of Defense will spend approximately $702 billion on C4ISR research projects and procurement in the decade spanning from 2006 to 2016, with information technologies accounting for an estimated $30.1 billion in 2006.[1] With such a large sum of tax dollars being invested in information technologies, it is imperative that the decision makers that allocate funds invest in the right systems that will prove most beneficial to the military services and the national defense.

B. PURPOSE

In the Department of the Navy Publication "FORCEnet: A Functional Concept for the 21st Century" the leaders of the United States Navy and Marine Corps propose FORCEnet as a capability which will "empower Sailors and Marines at all levels to execute more effective decision-making at an increased operational tempo" resulting in greater

[1] John Keller, Reductions Eyed for Battle Management and Information Technology Spending. *Military & Aerospace Electronics*. January 2006. Retrieved March 2006 from http://mae.pennnet.com/Articles/Article_Display.cfm?Section=ARTCL&ARTICLE_ID=245872&VERSION_NUM=2&p=32

effectiveness and mission accomplishment.[2] The FORCEnet concept is to serve as the catalyst for naval transformation and revolutionizing naval command and control. To realize FORCEnet, the US Navy and Marine Corps are poised to invest a great deal of resources to develop and adopt the technologies that will make it possible.

With the publication of Naval Warfare Development Command (NWDC) TACMEMO 3-32-03 “Joint Force Maritime Component Commander (JFMCC) Planning and Execution” in June 2004, the Navy, for the first time, formalized into doctrine the planning process to be executed by its commanders at sea. The planning process as executed today is very manpower intensive and is largely unsupported by information technology (IT) systems. This research will address the benefits of the development of and fielding of IT systems to support the crisis action planning process of the US Navy.

A case study, observed during the Trident Warrior 2005 experiment, will serve as a baseline “as-is” of the planning process. It will provide measures by which the incorporation of IT systems can be evaluated. In this research, the Knowledge Value Added (KVA) methodology will be used to compare the “as-is” process to the processes where notional IT systems are incorporated. The results of these comparisons will be provided to the US Navy as recommendations for or against the development of IT systems to aid the planning process.

C. RESEARCH OBJECTIVES

The objective of this research is to analyze the potential benefits of the development of FORCEnet IT systems to assist decision-making in turbulent environments. Specifically, this research will evaluate the JFMCC Planning Process as conducted during crisis action planning in Trident Warrior 2005. Prior to providing recommendations for future systems, a baseline analysis of the JFMCC planning process must be conducted to establish the current state of the process. With the baseline established, a future IT system can be evaluated within the process and the analysis of its impact conducted.

[2] Department of the Navy Publication, (2005) “FORCEnet: A Functional Concept for the 21st Century,” Introduction by Clark, V. Chief of Naval Operations and Hagee, M. Commandant of the Marine Corps, Washington: Department of the Navy.

D. RESEARCH QUESTION

The development of IT systems is a high risk endeavor. According to David Haas, writing in the Defense Acquisitions University periodical *Program Manager*, the failure rate of IT acquisitions programs is as high as 83%[3]. This high failure rate coupled with the vast sums of money allocated to IT systems requires that objective and quantifiable information be provided to decision makers so that the benefits of such programs are maximized in the processes they support.

The primary question of this thesis is: What is the value of FORCEnet IT systems when employed in turbulent decision-making environments, specifically the JFMCC planning process? The answer to this question will provide the decision maker a solid basis for selecting where the funds of today should be invested to provide the greatest return for the Navy of the future.

E. METHODOLOGY

This thesis will model the JFMCC planning process as conducted during the experiment Trident Warrior 2005 and establish the baseline analysis of the planning process using the KVA methodology. In conducting the KVA analysis, the return on investment for each of subprocesses and the planning process as a whole will be determined. With the return on investment baseline established, a hypothetical scenario with notional FORCEnet technologies will be evaluated to determine the impact of the IT systems within the JFMCC planning process.

F. SCOPE

The JFMCC Planning Process formalized in the Navy Warfare Development Command TACMEMO 3-32-03 is specific to crisis action planning at the operational and tactical levels of warfare. However, it is not specific to the US Navy. The JFMCC Planning Process is in concert with the US Army and US Marine Corps planning processes. Therefore, although this thesis uses the JFMCC planning process for analysis, the results of

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[3] David Haas, Government-wide Information Technology (IT) Acquisitions. *Program Manager*. 12. May June 2003. Retrieved April 2006 from http://www.dau.mil/pubs/pm/pmpdf03/may/has-m-j03.pdf

this thesis can provide insight to both the Army and Marine Corps decision makers for the acquisition of new IT systems to support the planning process of their respective service.

G. ORGANIZATION OF THESIS

This thesis will be organized in the following manner:

Chapter I will provide an overview of this research project and will present to the reader the primary objectives and questions on which it will focus. The research methodology and the scope of this thesis will be described.

Chapter II will provide the necessary information for understanding the JFMCC planning process as described in NWDC TACMEMO 3-32-03 that serves as the basis for the “as-is” model of the planning process. The topics covered in this chapter include the FORCEnet Functional Concept, the JFMCC Planning Process, a brief description of notional technologies to support the military planning, Return on Investment, and IT Acquisitions for the DoD.

Chapter III discusses the Knowledge Value Added (KVA) methodology in detail to enhance the readers understanding of the knowledge-based return on investment analysis from which this thesis draws its conclusions and recommendations.

Chapter IV will provide the analysis of the “as-is” planning process and will make prospective analysis of notional planning processes that incorporate IT systems to aid the human in accomplishing the planning.

Chapter V summarized the research presented and will state conclusions and provide recommendations to the Navy and the Department of Defense as a whole regarding the development of IT systems to aid the planning process.

II. LITERATURE REVIEW

A. FORCENET

The FORCEnet concept will serve as the primary driver of the transformation of the command and control of naval forces. FORCEnet ”...describes the principles, defines the capabilities, and reaffirms the necessity of co-evolving information technology with organization, process, and doctrine.”[4]

1. The FORCEnet Vision

In the FORCEnet Functional Concept document published by the Chief of Naval Operations and the Commandant of the Marine Corps, the leaders of the US Naval Forces called for the development of “adaptive, distributed networks of commanders, staffs, operating units, supporting organizations, sensors, weapons and other equipment interacting with one another on an underlying infrastructure, as well as the associated command and control policies, concepts, organizations… to allow them to interact.” The objective of these networks is to provide warfighting commanders with the ability to make better, timelier decisions than they currently can.[5] The various information technology systems which will support the networking of the above named facets of the forces are currently being investigated. However, each emergent technology does not hold equal value when placed in the context of the process it will support. For the functional concept to be realized, the information technologies that are being adapted must be analyzed individually and as a system of systems to assure that they are adding value to the processes accomplished by the warfighting commanders and staffs.

2. FORCEnet and Command and Control

> Command and control is the means and methods by which a commander recognizes that needs to be done in any situation and sees that appropriate actions are taken... It ranges from the intuitive judgments that only skilled and experienced people can perform to the precise, instantaneous determinations that only automation can perform.[6]

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4 Department of the Navy Publication, (2005) “FORCEnet: A Functional Concept for the 21st Century,” Introduction by Clark, V. Chief of Naval Operations and Hagee, M. Commandant of the Marine Corps, Washington: Department of the Navy.

5 Ibid., p. 1.

6 Ibid., pp. 6–7.

Command and control is not merely a human function; for example the terminal guidance of a missile provided by its onboard computer and Global Positioning System receiver is a form of command and control. For real-time command and control of this sort, a human decision maker can not process inputs in a timely manner to affect the course of flight appropriately. Other forms of command and control are more appropriate for human decision makers. The employment of military forces through the combined use of strategy, operations, and tactics is a form of command and control in which the leadership, as compared to direction, is at its fullest. This is the highest form of command and control.[7]

Among the capabilities that are required for the implementation of FORCEnet are:[8]

- Process, sort, analyze, evaluate, and synthesize large amounts of disparate information while still providing direct access to raw data as required.
- Provide each decision maker the ability to depict situational information in a tailorable, user-defined, sharable, primarily visual representation.
- Provide distributed groups of decision makers the ability to cooperate in performance of common command and control activities by means of collaborative work environment.
- Automate lower-order command and control sub-processes and to use intelligent agents and automated decision aids to assist people in performing higher-order sub-processes, such as gaining situational awareness and devising concepts of operations.
- Provide decision makers the ability to make and implement good decisions quickly under conditions of uncertainty, friction, time, pressure, and other stresses.

The FORCEnet concept is envisioned to allow for commanders operate in a collaborative command and control environment, with shorter decision cycles so that

[7] Department of the Navy Publication, (2005) "FORCEnet: A Functional Concept for the 21st Century," p. 7. Washington: Department of the Navy.

[8] The complete list of stated FORCEnet capabilities is found in the FORCEnet Functional Concept on pages 12 through 19.

decisions can be made are a tempo which the enemy cannot tolerate.[9] To develop the information technology required, they must be analyzed within the context of the human-centric high-order command and control processes.

The primary decision-making process of the warfighting commander is the planning process. To date, the planning process is not supported at the tactical level with IT that allows for more timely and accurate decision-making. For the FORCEnet concept to be realized, initiatives in IT to support the planning process must be developed and implemented.

B. THE JFMCC PLANNING PROCESS

1. Organization of the JFMCC Staff

With the publication of the NWDC TACMEMO 3-32-03, the organization of the JFMCC staff was formalized to provide a fully integrated naval staff at the operational level of war. The JFMCC Staff organization is based upon the requirement to support the JFMCC by:

- Integrating planning, execution, and assessment with the Joint Forces Commander, other component commanders, and subordinate JFMCC elements.
- Providing clear, concise, and uncomplicated plans and orders.
- Synchronizing the warfighting functions and missions areas throughout the maritime force to achieve unity of effort and to harmonize maneuver and maximize opportunities for surprise.
- Coordinate maritime response to emergent battlefield events ensuring economy of force to achieve a clear, decisive, and objective while ensuring adequate security.[10]

To this end, the JFMCC staff is organized into six centers: Knowledge Management, Maritime Intelligence and Analysis, Maritime Future Plans, Maritime Operations, Maritime

9 Department of the Navy Publication, (2005) "FORCEnet: A Functional Concept for the 21st Century." Washington: Department of the Navy, p. 1.

10 Navy Warfare Development Command (2004), "Navy Warfare Development Command TACMEMO 3-32-03: Joint Forces Maritime Component Commander (JFMCC) Planning and Execution," Newport, Navy Warfare Development Command, p. 3-1.

Logistics Coordination, and the Maritime Support Center. This organization scheme replaces the traditional J-coded staff organization (J-1 administration, J-2 Intelligence, J-3 Operations, J-4 Logistics, J-5 Plans, J-6 Communications) with more functional interrelationships within the various centers. Figure 1 demonstrates the proposed functional organization of the JFMCC staff:

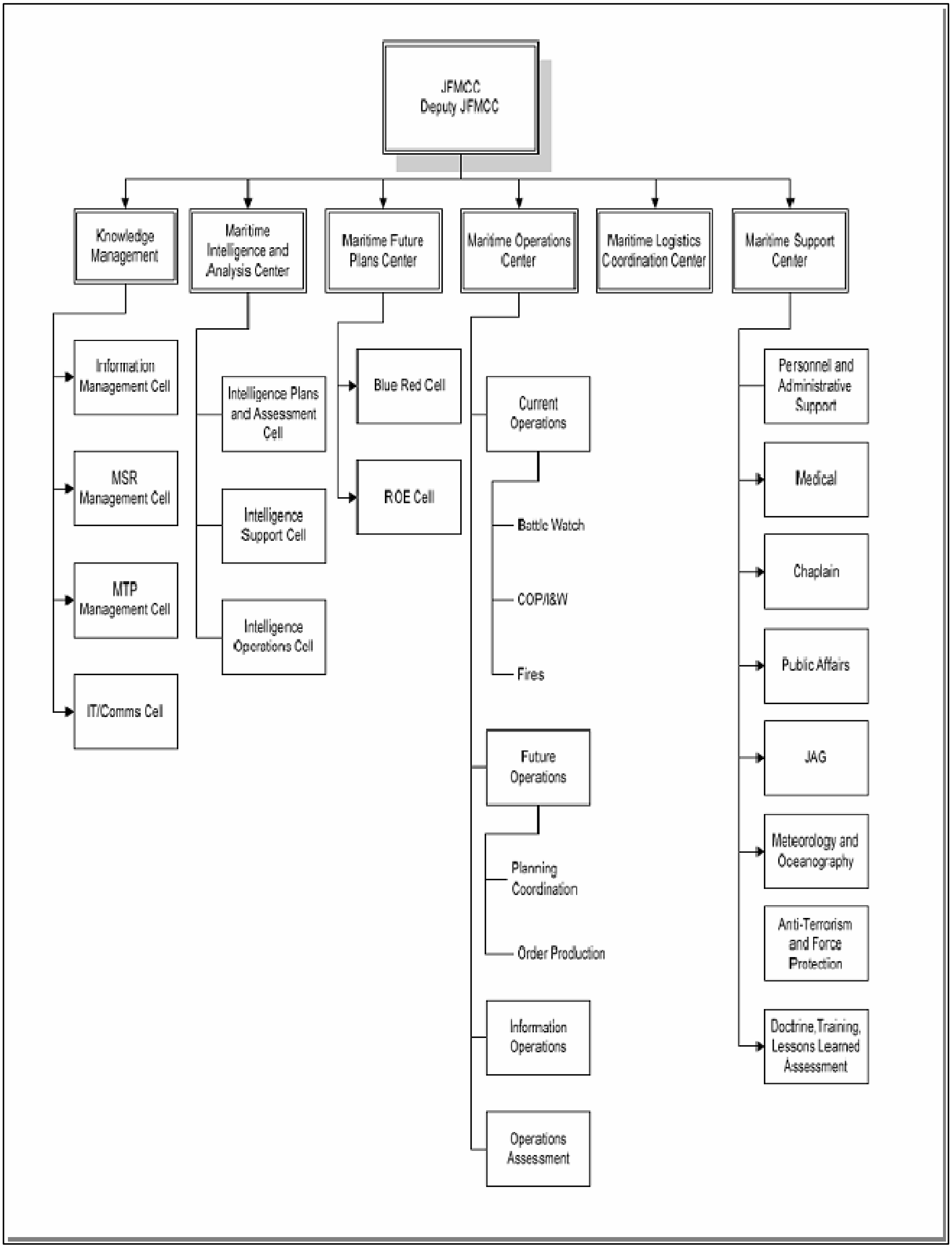

Figure 1. Organization of the JFMCC Staff (From NWDC, 2004)

2. Future Operations Cell

Within the Maritime Operations Center, the Future Operations Cell is the primary, near-term planning agent of the JFMCC. The Future Operations Cell translates operational objectives assigned to the JFMCC into tactical missions to be assigned to the subordinate maritime units. The Future Operations Cell is also responsible for synchronizing and coordinating the missions assigned to subordinate units to achieve unity of effort throughout the entire maritime component. As the Future Operations Cell is focused primarily on actions to be taken between 24 and 72 hours in the future, close coordination with the Current Operations Cell and the Maritime Future Plans Center is essential to their success. To these ends, the Future Operations Cell is organized into the Planning Team, the Maritime Tasking Plan/Maritime Support Request Coordination Team, the Orders Production Team, and the Liaison Team as depicted in Figure 2.

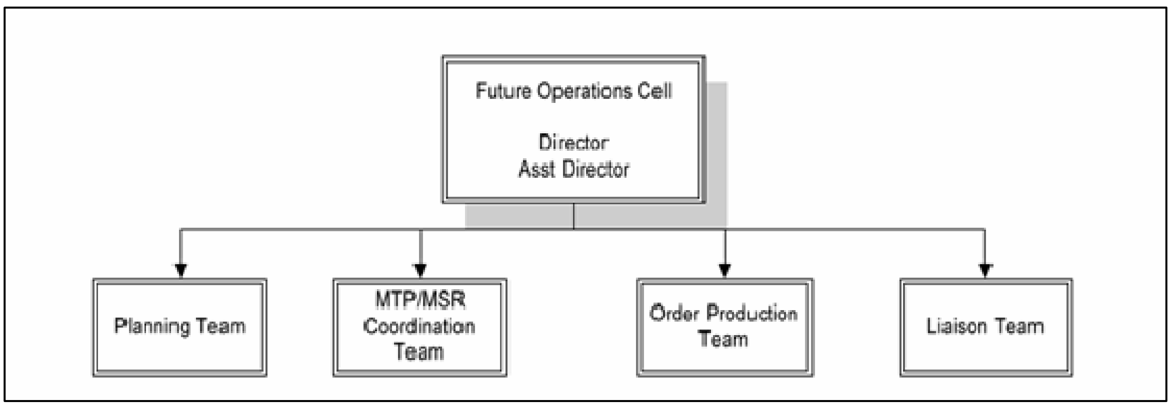

Figure 2. Organization of the Future Operations Cell (From NWDC, 2004)

3. The JFMCC Planning Process

The JFMCC Planning Process was formally established in June 2004 with the publication of NWDC TACMEMO 3-32-03. The TACMEMO provides guidance for the planning and execution of maritime operations that require coordination of Navy, Marine Corps, and coalition forces within an assigned area of operations.[11] The JFMCC planning process provides the means by which maritime forces submit inputs into the Joint, component, and subordinate planning processes to ensure a unity of effort in accomplishing

[11] Navy Warfare Development Command (2004), "Navy Warfare Development Command TACMEMO 3-32-03: Joint Forces Maritime Component Commander (JFMCC) Planning and Execution." Newport. Navy Warfare Development Command, Preface.

missions.[12] The JFMCC planning process is executed concurrent with the other component (Joint Forces Land Component Command, Joint Forces Air Component Command, Joint Forces Special Operations Component Command) planning processes upon receipt of the Joint Forces Command (JFC) Operations Order or Warning Order.

The JFMCC planning process is a top-down process to ensure unity of command throughout the maritime forces. The six steps to the JFMCC planning process are: Mission Analysis, Course of Action (COA) Development, COA Analysis, COA Comparison and Decision, Orders Development, and Transition. The JFMCC Planning Process is depicted as the six-step sequential process in Figure 3.

[12] Navy Warfare Development Command (2004), "Navy Warfare Development Command TACMEMO 3-32-03: Joint Forces Maritime Component Commander (JFMCC) Planning and Execution," Newport, Navy Warfare Development Command, p. 4-1

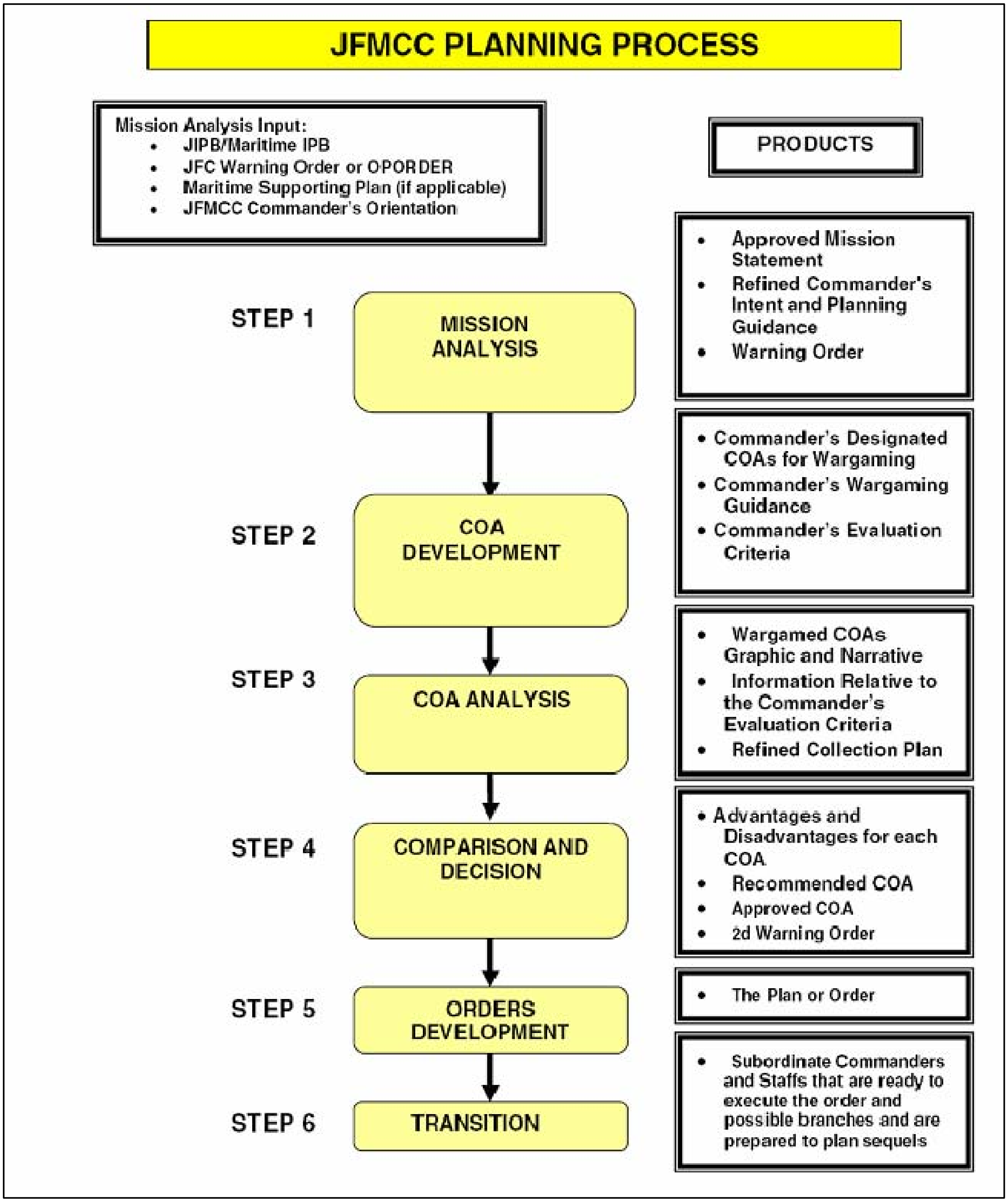

Figure 3. The JFMCC Planning Process (From NWDC, 2004)

Step 1 - Mission Analysis: The purpose of mission analysis is to conduct a review and analysis of orders, guidance, and any other information provided by the JFC to produce

a JFMCC mission statement. This step also provides a means by which the situational awareness of the commander is built and shared throughout the planning staff. The commander will deliver guidance and his intent to his planning staff to focus and facilitate further planning.

Step 2 - COA Development: With the JFMCC mission statement, commander's guidance, commander's intent and JFC mission statement, the planning staff develops COAs to accomplish the assigned mission. Multiple COAs may be developed to provide the commander with different methods of achieving the goal. Each of the COAs developed by the planning staff must be suitable, feasible, acceptable, distinguishable, and complete. They must also be in concert with the mission statement and commander's guidance and intent.

Step 3 - COA Analysis: During the COA analysis, the planning staff conducts a detailed assessment of each of the COAs developed it regard to the enemy and the battlespace. COAs may be compared to potential enemy COAs or reactions to determine strengths and weaknesses of the COA. This will also aid in development of branches (deviations from the plan bases upon unfolding events) or sequels (next steps that are taken upon completion of a plan). During the COA analysis, planners identify strengths, weaknesses, risks, and equipment or force shortfalls for each COA.

Step 4 - COA Comparison and Decision: During COA Comparison, the commander provides comparison criteria for all COAs and then compares them to each other. The staff and subordinate planners will provide to the commander their recommendations of which COA best accomplishes the mission from their perspective. The commander will then select the COA that he determines to best accomplish the mission.

Step 5 - Orders Development: To communicate the mission to the maritime forces, the staff prepares an operations order based upon the COA selected by the commander. The order must include the guidance and intent provided by the commander, along with the course of action and the individual subordinate missions.

Step 6 - Transition: The goal of the transition step is to ensure an orderly handover of the plan to those who will execute the operation. Further amplification of rationale or situational awareness may be required to ensure full understanding of the plan.[13]

The planning staff for the JFMCC planning process is an Operational Planning Team (OPT). The members of the OPT are members of the JFMCC future operations staff, liaison officers from adjacent and subordinate staffs, and other external personnel with subject matter expertise.

C. DECISION SUPPORT SYSTEMS TO AID THE PLANNING PROCESS

A Decision Support System (DSS) is a computer tool which assists human decision makers in making timelier or more informed decisions. In complex decision making processes with that are time critical and that have great associated risk, such as military planning, DSSs provide the greatest potential value. This research will examine a DSS suite which may provide automated support to the military planning processes through the use of artificial intelligence. Developed under funding by the Army Research Laboratory, the DSS suite comprised of the CoRaven, Weasel, and Fox may aid the planning process in unburdening military planners during crisis planning operations by aiding in the analysis of intelligence data, development of potential enemy courses of action for analysis, and generation of friendly courses of action. Figure 4 depicts the CoRaven, Weasel, and Fox suite within the intelligence collection and planning cycle.

[13] Navy Warfare Development Command (2004), "Navy Warfare Development Command TACMEMO 3-32-03: Joint Forces Maritime Component Commander (JFMCC) Planning and Execution," Newport, Navy Warfare Development Command, pp. 4-3 - 4-4.

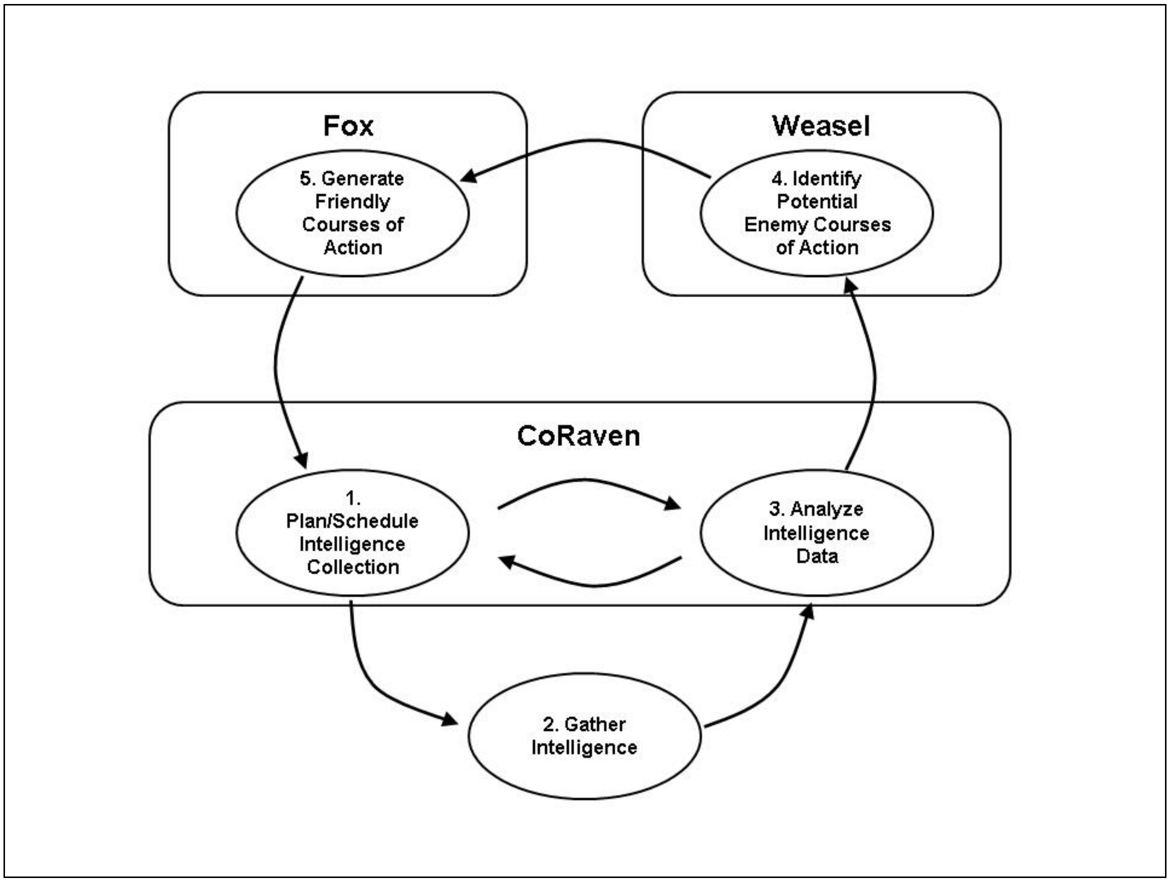

Figure 4. The Intelligence Collection and Planning Cycle (From Hayes, et al., 2002)

1. CoRaven

CoRaven is a decision support tool designed to aid in the planning process during times of crisis by processing a portion of intelligence data for the human operator. The goal of the CoRaven project is to support the human intelligence analyst with "an intelligent collaborative multimedia system." Using Bayesian networks[14] as its reasoning tool, CoRaven presents visual data to the operator through the use of spatial data in the form of

[14] Bayesian networks organize the knowledge in a field of interest as a branching series of cause and effect relationships between key variables. Given the known effects as observed by sensors or reconnaissance elements (e.g. troop concentration at a certain location and artillery battalion located at a certain firing position) the Bayesian network determines the probability of the potential causes (e.g., the enemy is attacking along Route Blue). More information regarding Bayesian networks can be found at http://www.niedermayer.ca/papers/bayesian and http://www.cs.ubc.ca/~murphyk/Bayes/bnintro.html. Retreived April 2006.

maps, temporal data in the form of synchronization matrices, and graph-based models for fusing data to determine supporting evidence.[15]

In order for the CoRaven DSS to be functional in times of crisis, the human operator inputs his own analytical logic into the system during times of calm, when time is available, in the form of logic trees.

2. Weasel

Weasel aids the military planner in developing potential enemy courses of action. Given data provided through intelligence analysis regarding the enemy forces disposition which is directly transferred from the CoRaven system, constraints of terrain, and intelligence assumptions, that are inputted by the human operator based upon enemy doctrine or displayed tendencies, Weasel generates a set of possible and likely enemy courses of action. Limitations of Weasel is that it does not identify enemy courses of action that are inconsistent with the given inputs and it does not designate a single course of action as that which would pose the greatest threat to friendly forces.[16] Figure 5 depicts the system components of the Weasel decision support tool.

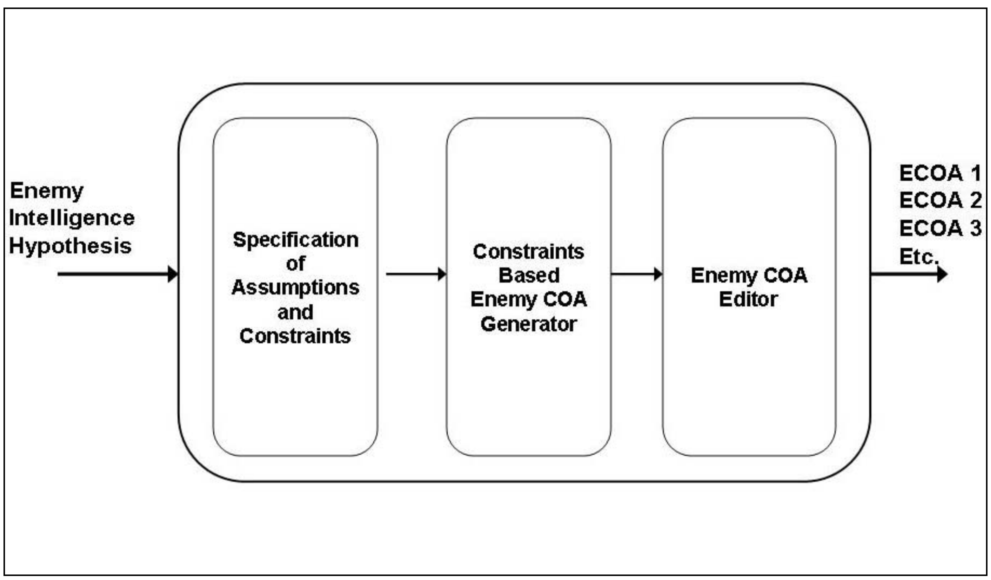

Figure 5. A System Diagram of Weasel Components (From Hayes, et al., 2002)

[15] P. Jones, et al (1999). "CoRAVEN: Modeling and Design of a Multimedia Intelligent Infrastructure for Collaberative Intelligence Analysis." Federated Laboratories Annual Research Symposium. Aberdeen. p. 914. Retrieved April 2006 from http://ieeexplore.ieee.org/iel4/5875/15656/00725532.pdf?arnumber=725532

[16] C. Hayes, A. Larson, U. Ravinder (2002), "Weasel: A Mixed-Initiative System to Assist in Military Planning." American Association of Artificial Intelligence. p. 3. Retrieved April 2006 from http://www.cs.rochester.edu/research/mipas2005/final-drafts/hayes-larson-ravinder.pdf

With Weasel, the military planner can repeat the course of generation multiple times varying the inputted constraints or can modify the produced courses of action through the graphical user interface. After refining the set of potential enemy courses of action the planner would then select a set of most relevant or most likely course of action against which friendly actions can be evaluated.[17]

3. Fox

Fox is a DSS which assists military planners in identifying potential friendly courses of action. Given a set of potential enemy courses of action, Fox uses a genetic algorithm[18] to generate potential friendly courses of action.[19] Comparing each potential friendly course of action to the inputted enemy courses of action, Fox identifies those friendly courses of action with the better performance in terms of a "fitness function," which is computed based upon the simulators measure of the remaining strength of friendly units, the remaining strength of enemy units, or the amount of terrain gained/lost during the battle.[20] Given the Fox output, the human decision maker is required to select which course of action for development into orders for execution.

D. RETURN ON INVESTMENT

1. Return on Investment Defined

The term Return on Investment (ROI) most commonly means "... a performance measurement used to evaluate the efficiency of an investment or to compare the efficiency of a number of different investments. To calculate ROI, the benefit (return) of an investment

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[17] C. Hayes, A. Larson, U. Ravinder (2002), "Weasel: A Mixed-Initiative System to Assist in Military Planning." American Association of Artificial Intelligence. p. 8. Retrieved April 2006 from http://www.cs.rochester.edu/research/mipas2005/final-drafts/hayes-larson-ravinder.pdf

[18] A genetic algorithm is a solution technique which tests a set of solutions against the problem to determine an optimal solution. The initial set of solutions are randomly created and then tested against the problem. The most "fit" of the solutions are modified and selectively combined with other solutions to create the next generation of solutions. This next generation is then tested for "fitness." This iterative process continues until a predetermined termination criterion is achieved (e.g., a certain number of generations into the algorithm, time, or no improvement in fitness is achieved through mutation). Retrieved April 2006 from http://en.wikipedia.org/wiki/Genetic_algorithm.

[19] U. Ravinder, & C. Hayes (2003). "Weasel: An Automated Planner that Users Can Guide," IEEE Systems, Man and Cybernetics (Washington, October 5-8, 2003). p. 955. Retrieved April 2006 from http://ieeexplore.ieee.org/iel5/8811/27871/01243937.pdf?arnumber=1243937

[20] C. Hayes, J. Schlabach, C. Fiebig (1998), "FOX-GA: an Intelligent Planning and Decision Support Tool" Systems, Man, and Cybernetics, 1998. 1998 IEEE International Conference on Volume 3, 11-14 Oct. 1998, p.2458.

is divided by the cost of the investment; the result is expressed as a percentage or a ratio."[21] To express ROI as a percentage, the formula for calculation is :

$$ROI = \frac{(Revenue - Cost)}{Cost} \times 100\%$$

When calculating the ROI of an individual investment, a negative ROI (less than 0.00%) implies that then investment generates a net loss. An ROI of 0.00% implies that the investment "breaks even," with no net gain or loss of investment. A positive ROI implies that the investment generates a profit for the investor.

This measure of ROI is of greater value to an investor when two or more alternative investments are compared against each other. For example, if one investment provides a higher ROI than an alternative, a logical conclusion is that the investor should invest in the investment with the higher ROI.

Measuring ROI for a commercial organization is a similar process. The analyst needs to determine the costs associated with the investment (equipment, manpower, etc.) and the potential future returns that will be generated by the investment. For example, if a company was evaluating whether to invest in a radio advertisement campaign they would calculate the costs (production, airtime, etc) and the potential returns (revenue generated by the campaign). If the costs were calculated to be $40,000 and the revenue projected to be $75,000, the ROI for the campaign would be 87.5% (ROI = [($75,000 - $40,000)/$40,000] x100%). This measure could then be compared to the alternatives of advertising on television or the alternative of not advertising (for which ROI is undefined).

2. Non-Profit ROI

A non-profit organization has been defined as an organization "which exists to do good, where the mission is a moral absolute, rather than an economic decision." A nonprofit organization can be categorized as performing one of the four nonprofit core

[21] Return on Investment (ROI). In Investopedia.com Dictionary. Retrieved March 2006 from http://www.investopedia.com/terms/r/returnoninvestment.asp

functions: promoting civic or political engagement, providing critical services, providing a vehicle for entrepreneurship, or acting as an outlet for the expression of faith and values.[22]

While the ROI of a commercial enterprise can be evaluated by looking at historical or projected data for costs and revenues, a non-profit organization can not be as easily evaluated. In the non-profit organization, cost data is available (manpower, equipment, infrastructure, etc.), but revenue generated is not available because no monetary value is assigned to the organizations product. For such an organization, a method for determining the revenue generated must be developed for an ROI analysis to be conducted.

Like the nonprofit sector, the costs associated with public sector organizations (i.e. government agencies) are also easily determined. Annually, budgets are submitted, reviewed, and approved by government organizations and public funds from taxes are allocated for the organizational expenses to provide services to the citizens. This budget data presents costs, but does not determine the value of the critical services that the public sector organization provides.

As with the nonprofit organization, government organizations do not easily lend themselves to an ROI analysis by virtue of the lack of revenue generated by the organization. Government services are not provided in a free market, largely because no single primary benefactor of a government service exists. Rather, the community as a whole benefits from the public sector organization. The value of fire departments and police departments is easy to theoretically grasp, so much that the existence of these organizations are largely unquestioned. However, since these organizations are not revenue generators in a market sense, one cannot readily assign a monetary value to the outputs generated by them (e.g. sense of security). Since the services provided by public sector organizations are not open to free market competition, where the outputs are available from multiple sources at varying degrees of quality and price, revenues need to be determined through other means.

It is commonly accepted that an ROI analysis of a private sector organization can provide information on where investments should be made to increase the profitability of the organization. For the public sector organization, increased profitability is not a likely

[22] M. Dube, B. Vetting (2004), "MBA Professional Report: Lessons for the DoD from the Nonprofit Sector." Monterey, Naval Postgraduate School, p. 3.

outcome, since no profit is currently achieved. Rather, an ROI analysis will potentially demonstrate where costs in the system to produce the service output can be improved through efficiency so that a more economical use of public funds can be achieved.

3. Information Technology ROI

As stated in the FORCEnet Functional Concept, one of the capabilities required to achieve the FORCEnet vision is to "automate lower-order command and control functions and use intelligent agents and automated decision aids to assist people in performing higher-order sub-processes, such as gaining situational awareness and devising concepts of operations." Through the implementation of information technologies to accomplish lower-order tasks, it is envisioned that those subprocesses that require little or no judgment will be conducted more efficiently and with greater accuracy than a human operator could. The human who currently is employed with these tedious tasks could be freed to conduct subprocesses requiring greater human judgment. The resulting efficiency in use of human capital will present itself in lower costs with the labor intensive tasks and will likely improve the ROI of the process as a whole.

Given the benefits envisioned through the implementation of information technologies in command and control processes, a means to objectively and consistently measure the impact of an investment on the processes they operate within is required.

a. Current Approaches

There are currently a number of approaches to measuring the impact of information technology on an organizations performance. Table 1 summarizes these approaches and their associated advantages and disadvantages:

Common Approaches to Measuring the Return on IT						
Level of Analysis	Approach	Focus	Example	Key Assumption	Key Advantage	Limitation
Aggregate Corporate (firm) level	Process of Elimination	Treats effect of IT on ROI as a residual after accounting for other capital investments	Knowledge capital (Strassmann 2000a, b)	ROI on it difficult to measure directly	Uses commonly accepted financial analysis techniques and existing accounting data	Cannot drill down to effects of specific IT initiatives
	Production Theory	Determines the effects of IT through input output analysis using regression modeling techniques	Brynjolfsson & Hitt (1996)	Economic production function links IT investment input to productivity output	Uses econometric analysis on large data sets to show contributions of IT at firm level	"Black-box" approach with no intermediate mapping of IT's contributions to outputs
	Resource-Based View	Linking firm core capabilities with competitiveness	Jarvenpaa & Leidner (1998)	Uniqueness of IT resource = competitive advantage	Strategic advantage approach to IT impacts	Causal mapping between IT investment and firm competitive advantage difficult to establish
Corporate/ sub-corporate	Option Pricing Model	Determines the best point at which to exercise an option to invest in IT	Benaroch & Kauffman (1999)	Timing exercise option = value	Predicting the future value of an IT investment	No surrogate for revenue at sub corporate level
Sub-corporate (Process)	Family of Measures	Measure multiple indicators to derive unique contributions of IT at sub-corporate level	Balanced score-card (Kaplan & Norton, 1996)	Need multiple indicators to measure performance	Captures complexity of corporate performance	No common unit of analysis/ theoretical framework
	Cost-Based	Use cost to determine value of information technology	Activity-based costing Johnson & Kaplan (1987)	Derivations of cost ≈ value	Captures accurate cost of IT	No surrogate for revenue at sub corporate level -- no ratio analysis
	Knowledge Value Added	Allocating revenue to IT in proportion to contributions to process outputs	Housel & Kanevksy (1995)	IT contributions to output ≈ IT value-added	Allocates revenue and cost of IT allowing ratio analysis of IT value-added	Does not apply directly to highly creative processes

Table 1. Common Approaches to Measuring the Return on IT (From Pavlou, P., et al., 2005)

These approaches can be categorized into two groups based upon the levels at which they analyze the impact of the information technology, the corporate level and the sub-corporate level. The corporate level analysis approaches seek to determine the contribution of assets on the overall performance of the organization. The sub-corporate

approaches attempt to look internal to the organization at the processes which produce the organization's output and to measure the impact of assets within these processes. The overall goal for each of these approaches is to provide to the decision maker a measure of the impact of information technology investments at the particular level at which they analyze.

b. DoD Information Technology Investments

The Information Technology Management Reform Act of 1996, commonly known as the Clinger-Cohen Act, had a dramatic impact on the federal government and the way by which information technologies were developed and purchased. The Clinger-Cohen Act mandated that the Chief Information Officers review the acquisition of information technology systems and provide accountability for the investments made.[23] The Clinger-Cohen Act directed that the acquisition of, planning for, and management of technology be treated as "capital investments" and that DoD, along with all other federal agencies, conducts a cost/benefit analysis of the technology prior to purchase.[24]

The following chapters provide detailed background information of the Knowledge Value Added methodology and demonstrate the use of the methodology as a means of conducting this cost/benefit analysis within the process that the technology would support.

[23] M. Browning, (June 20, 2005). "Executive Suite: Putting the Clinger-Cohen Act into Perspective." *Government Computer News*, 24. Retrieved April 2006 from http://www.gcn.com/24_15/project-management/36103-1.html

[24] Department of Education. "Clinger-Cohen Act." Retrieved April 2006 from http://www.ed.gov/policy/gen/leg/cca.html.

III. THE KNOWLEDGE VALUE-ADDED METHODOLOGY

A. THE VALUE PROBLEM

The Clinger-Cohen Act directs that a cost/benefit analysis for IT systems be conducted prior to the acquisition of the systems. To be mathematically correct, in determining the ROI for an IT investment, the value of an investment must be established in a unit of measure common with the cost of the investment. Since the "cost" associated with IT investments is monetary, the value derived from the benefits must also be stated in monetary terms. In private sector organizations, the monetary value can be measured when assigning the unit price to the process output. However, this measure of value does not provide a complete understanding of the value of the investment made. It captures the value only at the boundary between the process and the free market. It does not determine the value of the process assets that work within the organization to produce the final product.

In nonprofit and public sector organizations the difficulty of assigning value to an investment is greater. The DoD, for example, is incapable of determining directly the monetary value of IT investments because it does not offer its process outputs to the free market. Therefore it is necessary that an alternative common unit be used in determining the value of investments.

B. THE KNOWLEDGE VALUE-ADDED METHODOLOGY

The Knowledge Value-Added (KVA) methodology provides a framework for determining the value of subprocesses and process assets within an organizational process. Developed by Dr. Thomas Housel and Dr. Valery Kanevsky of the Naval Postgraduate School, KVA addresses the longstanding need of executives and managers to be able to measure the value of the knowledge that exists within employees, processes, and IT. The KVA analysis produces a return-on-knowledge (ROK) ratio to show the estimated value added by process assets to the final process output.

1. KVA Theory

The KVA methodology was developed on the concepts of entropy and complexity[25], stating that organizations add value through its core processes by changing the process inputs (e.g. raw materials, labor, energy, information) into the process outputs (e.g. products and services) that generate the organization's revenue.[26] The amount of change that occurs to the input to create the output can therefore be a measure of the value added during the process.

KVA uses a knowledge-based metaphor to operationalize the relationship between the change that occurs to the input to generate the output through the organizations core processes. The amount of change can be described in terms of the amount of knowledge required to make that change. Figure 6 depicts the key assumptions of the KVA methodology.

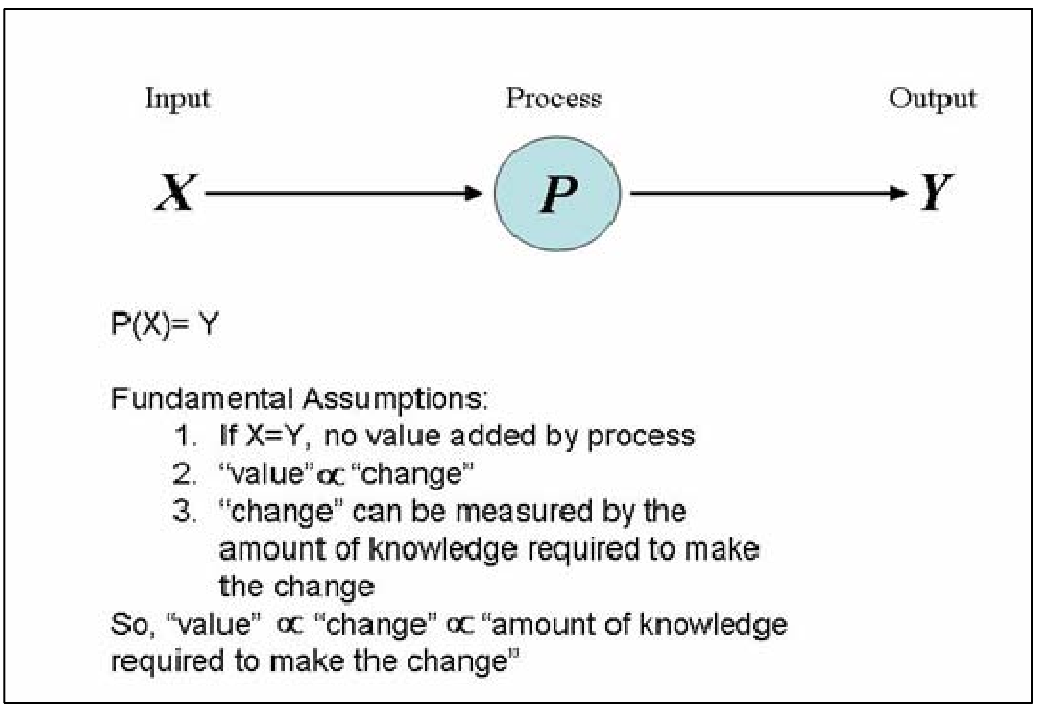

Figure 6. Fundamental Assumptions of KVA (From Housel & Bell, 2001)

[25] In simple terms, the Kolmogorov Complexity (K-Complexity) of an object is the length of the shortest possible computer program which can replicate the object. A more complex object requires a greater amount of knowledge to replicate. ("Greg Harfst's Home Page: Kolmogorov Complexity." Retrieved April 2006 from http://nms.csail.mit.edu/~gch/kolmogorov.html).

[26] T. Housel, & A. Bell, (2001), Managing and Measuring Knowledge. Boston: McGraw-Hill Higher Education. pp. 91–92.

2. Identification of Core Processes

In order to utilize the KVA methodology, the core processes of the organization that creates the output from inputs must be identified and the change that occurs to the process inputs within these processes must be defined. To this end various sources of information may be called upon to ensure that the completeness of the list. For example, an analyst may use a survey of organizational managers or executives, queries of subject matter experts who are familiar with the organization, or procedural publications or checklists that identify the processes in a linear system. Key to the identification of the core processes is the identification of the boundaries of the processes, where the process outputs can be identified for each individual core process prior to the initiation of a proceeding process.

3. Approaches to Measuring Knowledge

The knowledge within an organization's processes can be measured through various means so long as the basic assumptions of KVA are satisfied and the approach is used to consistently throughout the core process. For the purposes of this research, the Learning Time, Process Description, and Binary Query Method techniques are presented in Table 2, with the Learning Time Approach described in greater detail in narrative.

Step	Learning Time	Process Description	Binary Query Method
1.	Identify core process and its subprocesses.		
2.	Establish common units to measure learning time.	Describe the product in terms of the instructions required to reproduce them and select unit of process description.	Create a set of binary yes/no questions such that all possible outputs are represented as a sequence of yes/no answers.
3.	Calculate the learning time to execute each subprocess.	Calculate number of process instructions pertaining to each subprocess.	Calculate length of sequence of yes/no answers for each subprocess.
4.	Designate sampling time period long enough to capture a representative sample of the core process's final product/service output.		
5.	Multiply the learning time for each subprocess by the number of times the subprocess executes during the sample period.	Multiply the number of process instructions used to describe each subprocess by the number of times the subprocess executes during the sample period.	Multiply the length of yes/no string for each subprocess by the number of times the subprocess executes during the sample period.
6.	Allocate revenue to subprocesses in proportion to the quantities generated by step 5 and calculate the cost for each subprocess.		
7.	Calculate ROK, and interpret results.		

Table 2. Three Approaches to KVA (From Housel & Bell, 2001)

a. The Learning Time Approach

Of the various methods of estimating the knowledge required to generate process output from input, the learning time is most often utilized in core processes with a high degree of human interaction. The Learning Time Approach provides a convenient estimation because the knowledge required to execute a process is proportional to the time required to learn it. Therefore, the average time required for a person to learn how to execute a process is proportional to the amount of new knowledge required.[27] Learning time must be measured in terms of common units of time throughout the processes of interest, and it is these common units that become common units of output.

b. Reliability of Learning Time Estimation

Although the Process Instruction and Binary Query Method approaches to measuring the knowledge required to create a process output are more accurate than the Learning Time Approach, for many processes such detailed information is not readily available. To use the Learning Time Approach to measure knowledge requires that the analyst be able to establish the reliability of the estimates. Reliable estimates of learning time can be made when there exists formal training or education requirements to execute a core process. In such a case, the time actively spent learning will provide a very sound measure of the knowledge required. However, within many organizations, the knowledge required to execute the core processes is learned by observation and execution of the core processes. In this case, where time is not specifically allocated to learning the required knowledge, estimation of learning time is required. To establish reliability of the estimates, multiple executives, managers, or subject matter experts with in depth familiarity with the overall core process may be surveyed to determine the relative time that must be dedicated by a new "average" employee to learn all knowledge to execute the core process. The estimates provided by these multiple sources can be statistically compared to each other to identify the level of correlation that exists between respondents. A correlation of 80% or greater between responses is sufficient to establish reliable estimates of the relative knowledge embedded within the processes.

[27] V. Kanevsky, T. Housel (1998), "The Learning-Knowledge-Value Cycle" in Knowing in Firms: Understanding, Managing, and Measuring Knowledge. G. Von Krogh, J. Roos, D. Kleine (Eds), New York: Sage. p. 273.

IV. METHODOLOGY PROOF OF CONCEPT

A. INTRODUCTION

The Trident Warrior Experiment is the annual FORCEnet sea trial event that was designed to create an "environment in which to assess, in quantitative and qualitative terms, FORCEnet systems including technology, tactics/techniques/procedures (TTP's)—providing specific insights and dedicated procurement and development decision information."[28] The experimentation, led by the Naval Network Warfare Command (NNWC), is conducted in a realistic fleet environment aboard vessels at sea to provide recommendations to the Military Utility Assessment (MUA) Board regarding the adoption of the technologies and processes examined in both qualitative and quantitative measures.

Along with serving as the Navy's Functional Component Commander to the US Strategic Command, NNWC's Global Mission is to create "warfighting and business options for the Fleet to fight and win in the information age. (To) deliver and operate a reliable, secure and battle-ready global network. (To) lead the development and integration of Information Operations capabilities into the Fleet." With the guiding principle of the FORCEnet Functional Concept as the means, NNWC seeks to provide the Naval Command and Control for the 21st Century.[29] To this end, the Trident Warrior experiments serve as a primary source of reliable information to the Commander of NNWC regarding technology and processes which should be adopted or accelerated through the procurement process.[30]

The following proof-of-concept will be used as the "as-is" process with information collected from observation and survey of the Second Fleet staff execution the mission planning required during the experiment. The KVA methodology will be applied to analyze the theory that process re-engineering and automation will provide significant improvement to the planning process in terms of efficiency. Notional information technologies will be

[28] Naval Network Warfare Command, "TW 05 Overview" PowerPoint Presentation presented by Brad Poeltler, TW 05 Deputy Director 11 August 2005.

[29] Naval Network Warfare Command, "NETWARCOM Mission Statement and Guiding Principles". Retrieved April 2006 from https://ekm.netwarcom.navy.mil/netwarcom/nnwc-nipr/index.htm

[30] Naval Network Warfare Command, "TW 05 Overview" PowerPoint Presentation presented by Brad Poeltler, TW 05 Deputy Director 11 August 2005.

introduced in "to-be" scenarios. The effects of the notional information technologies will be determined through a KVA analysis, which will be compared to the current "as-is" process.

B. SECOND FLEET PLANNING PROCESS IN TW 05

In order to determine the effects of future information technologies in the planning process, a baseline measure of the current "as-is" process must be made. During Trident Warrior 2005 (TW 05), which was held in November-December 2005 in the Virginia Capes region, Commander Second Fleet (C2F) served in the role of the Coalition Forces Maritime Component Commander (CFMCC).

The C2F Future Operations Department (FOPs) is largely responsible for the development of the operational plan for C2F. During TW 05, the FOPs developed one operational plan focusing on the exploitation of a scenario terrorist camp. As part of the task received from the notional Joint Task Force Headquarters, C2F, as CFMCC, was directed to "conduct military operations to conduct sensitive site exploitation" and to capture suspected terrorist ringleaders.

Throughout TW 05, Subject Matter Experts (SMEs) from the C2F staff were surveyed in order to identify the subprocesses of the planning process. The C2F Planning Process, as agreed by these SMEs, can be defined in the sequential subprocesses:

- Mission Analysis: Analysis of the current enemy forces, friendly forces, and the task assigned by higher headquarters.
- Course of Action (COA) Development: Development of feasible options from which the CFMCC may prosecute the assigned task.
- COA Analysis: Evaluation of the COAs developed in terms of the principles of leverage, operational maneuver, synergy, tempo, balance, objective, and agility. The COAs are also evaluated by the staff in terms of subject area in terms of supportability within that subject matter.
- COA Comparison and Decision : Presentation of the COAs and the analysis to the CFMCC for a determination of which is to be adopted for further development into the Concept of Operations (ConOps) which will be executed to fulfill the assigned mission. The CFMCC may additional

provide amplifying remarks and questions which will alter the COA selected. The CFMCC also has the option of rejecting all COAs developed and require that planning start anew.

- ConOps Development: The selected COA is further developed in detail to a level of clarity that allows for it to be executed by subordinate commands.
- ConOps Approval: The detailed ConOps is presented to the CFMCC to ensure that the staff has developed it to his satisfaction. Further guidance may be received direction modification of the ConOps or the ConOps may be accepted by the CFMCC.

This planning process is similar to the JFMCC Planning Process as presented in the Navy Warfare Development Command (NWDC) TACMEMO 3-32-03, with the exception of the ConOps Development and ConOps Approval subprocesses. In the NWDC TACMEMO, the ConOps Development is included in the COA Comparison and Decision subprocess while the ConOps Approval is part of the Orders Development subprocess.[31]

The C2F FOPs assigned an Operational Planning Team (OPT) to conduct the planning for the assigned mission. Individuals selected for assignment to the OPT were assigned on a basis of availability and subject area expertise. The OPT consisted of:

OPT Leader:	USN O-5
OPT Intelligence Planner:	USA O-5
OPT Land Planner:	USA O-4
OPT Ground Fires Planner:	USA O-4
OPT Special Operations Forces Planner:	USN O-3

Other CFMCC Planners that interacted with the planning process were:

CFMCC:	RN Commodore
C2F Operations:	USN O-6
C2F Future Operations Officer:	USMC O-5
Iwo Jima Expeditionary Strike Group (ESG) Commander:	USN O-6
24th Marine Expeditionary Unit (MEU) Executive Officer:	USMC O-6

[31] Navy Warfare Development Command (2004), “Navy Warfare Development Command TACMEMO 3-32-03: Joint Forces Maritime Component Commander (JFMCC) Planning and Execution”. pp. A-29 to A-33. Newport, Navy Warfare Development Command.

C2F Information Operations Planner:	USAF O-5
C2F Fires:	USAF O-4
ESG Planner:	USN O-3
MEU Planner (S-2A):	USMC O-3
MEU Planner (S-6A):	USMC O-3

The planning process was initiated on Monday 5 December with the receipt of the order tasking from the White Cell in the role of the JTF Commander. Mission Analysis was conducted for a period of 1.5 hours, an artificiality brought about by the Trident Warrior Experiment. The week prior to the experiment, the staff had executed planning on the same objective, and thus the Mission Analysis presented on 5 December was a product of 28 November. The amount of time dedicated during the 28 November planning exercise to the development of the Mission Analysis was reported to be four hours by the OPT Land Planner and 16 hours by the OPT Intelligence Planner. For the KVA analysis, the initial time required for Mission Analysis was applied for calculations of knowledge and cost. The Mission Analysis results were then presented to the CFMCC with four suggestions for COA Development. The CFMCC rejected one of the COAs as unfeasible in accomplishing the assigned task.

Following the Mission Analysis, COA Development was undertaken by the planning team. The OPT Leader, based on the CFMCC guidance, determined that three COAs were to be developed for analysis. The three COAs were “Political Influence,” “Non-kinetic Information Operations,” and “Raid.” The OPT Leader assigned responsibility for the development of these three COAs to three different individuals based on their expertise. He assigned himself as the Political Influence COA lead, the C2F Information Operations Planner as the Non-Kinetic Information Operations COA lead, and the 24th MEU staff was assigned the Raid COA.

Upon completion of the COA Development, a meeting was convened for COA Analysis and staff estimation. The COA leads presented the COAs developed by their particular team. Upon completion of the presentation of the COAs, the COAs were evaluated by the collective group in terms of the principles of leverage, operational maneuver, synergy, tempo, balance, objective, and agility. This was conducted in the open

forum to allow all members of the audience to inject comments for group consideration. The COAs were also evaluated by the staff in terms of supportability within their subject matter expertise. The results of this analysis were recorded for presentation to the CFMCC.

Following the COA Analysis conducted by the planning staff, the FOPs Officer and the OPT Leader presented the COAs to the CFMCC, Operations Officer, ESG Commander, and the MEU Commander. The CFMCC directed that the Raid COA be developed as the ConOps with the modification that the developed ConOps include an alternate insertion method.

Following the CFMCC's decision, the planning team from the 24 MEU that developed the Raid COA convened to develop the ConOps for the raid as directed by the CFMCC.

Upon completion of ConOps Development, the ConOps was presented to the CFMCC for approval. The CFMCC approved the ConOps as presented with no modification, only amplifying remarks.

With the CFMCC’s approval, the ConOps would be further developed into the operations order for delivery to and execution by the subordinate commands. This further development of the operations order did not occur during TW 05 due to exercise considerations.

C. DATA COLLECTION METHODOLOGY

The data for this research was collected throughout the TW 05 experiment aboard the USS IWO JIMA. During the data collection, members of the C2F, IWO JIMA ESG, and 24 MEU staffs were observed and surveyed. The C2F Planning Process, as described above, served as the framework in which data was collected.

1. Assumptions

a. Length of Sample Period

The sample period for this analysis was four work days (a single iteration of the planning process). For this reason, some annual cost data is adjusted to reflect this sample period.

b. *Cost of Human Capital*

Manpower costs for this analysis were derived from the CY 2005 military pay scale available from the Defense Finance and Accounting Service[32] and the Basic Allowance for Housing Calculator available from the Department of Defense Per Diem, Travel and Transportation Allowance Committee.[33] To determine the costs associated with the planning process and subprocesses, estimated salary data was determined for each of the actors involved. This data included the base pay salary for one month and the Basic Allowance for Housing (BAH) for one month. This salary value was then multiplied by 12 months to determine the yearly salary and housing allowance for the actor. This yearly total was then divided by 2000 hours to determine the cost of that individual for one hour. This value was then multiplied by the time required to accomplish a subprocess for that actor. For the CFMCC, the US equivalent of an O-7 was used in determining salary data. For all actors the Norfolk, VA BAH with dependants rate was used with the exception of the 24th MEU actors, for whom the Jacksonville, NC BAH with dependants rate was used. Both base pay and BAH data was determined using the 2005 scale.

c. *Proxy Revenue Assumptions*

Proxy revenue values are based on the assumption that commercial organizations produce a comparable product or service as the public sector organization and that the processes which generate this output is comparable to that of the public sector organization. As market forces have placed a "value" on the commercial product which yields the revenue stream for the commercial organization, this "value" can be applied to the public sector organization's product or service for the sake of generating an analytical or hypothetical revenue generating stream. For this research, three consulting firms which produce business strategy plans were surveyed to yield a market comparable value of the planning process.

[32] DoD, *2005 Military Pay Rates*. Retrieved February 2006 from http://www.dod.mil/dfas/militarypay/2006militarypaytables/militarypaypriorrates/paytable2005-rev1.pdf.

[33] DoD, Basic Allowance For Housing Rates Calculator. Retrieved February 2006 from https://secureapp2.hqda.pentagon.mil/perdiem/bah.html.

Debra Conkey Communications

Debra develops strategic marketing, advertising, employee communications and public relations programs for clients worldwide, and includes both traditional and Internet-based strategies. She builds long-term relationships with people, so clients can expect consistent, impactful results. Debra can assemble and project manage a virtual team of experts to meet your more specialized needs. This could include the research, development, marketing, and tracking of a Web site, creating an interactive press kit about your product or service that can be downloaded from the Internet by the news media, developing and implementing an integrated plan for your travel, medical, high-tech or other business, and more. Debra has won 38 awards and was named Communicator of the Year by the International Association of Business Communicators in 1995. (http://www.thecommunicators.org/dir/debra-conkey.html)

Estimated retail value of Plan: $7,500.[34]

MarCom Interactive

We *strategize and implement* modern media. We translate modern media, make it relevant and apply it to our clients' marketing and communications needs.

We immerse ourselves in what is happening in modern media around the globe so we can detect trends and help you create opportunities. We show you how people are interacting with modern media so together we can craft new ways to implement your marketing communications or to add some inspiration to your brand.

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We provide fresh ideas, inspiration, and creativity and we do it with passion, professionalism and attention to what you need.

Our seminars, modern media reports, webcasts, articles, and The Modohood (here at our web site) is a great place to begin to explore what modern media is and what you can do for your organization. (http://marcominteractive.com/about/)

[34] D. Conkey. Telephone conversation with Debra Conkey on 25 January 2006.

Estimated value of Plan:$20,000 to $50,000.[35]

Solute Consulting

Founded in 2002, Solute is a young company whose principals and employees possess a strong history of contract support to the US Navy, extensive operational military experience and a wealth of technical expertise that will be leveraged to offer our customers a unique skill-set. Solute's team of consultants has considerable experience supporting the US Navy both directly and as Prime Contractors in a variety of projects.

The mission of all members of the Solute Consulting team is to be the premier Network Centric consulting firm in the world. All of our team members strive to provide our clients with unsurpassed expertise in all aspects of Network Centric Warfare and Information and Knowledge Management, as well as mapping the information flow and the implementation of Collaborative Tools in a tactical environment.

Combining technical expertise and vast military and tactical experience, Solute Consulting profoundly enhances the Warfighters ability to gather and manage information in a networked, collaborative environment. (http://www.solute.us)

Estimated value of Plan: $15,000 to $25,000.[36]

For this research, the mean value of the lowest and highest estimates, $28,750, is used as the market-comparable value of the planning process output.

D. KVA ANALYSIS OF THE "AS-IS" PLANNING PROCESS

1. Determining the Revenue Generated by Subprocesses

The method used to establish estimates of the knowledge resident in the C2F Planning Process was the Learning Time Approach. Through interviews with subject matter experts resident in the C2F FOPs, the processes within the planning process were agreed upon as described above, with boundaries established between the subprocesses in order to utilize the KVA methodology and to establish a valuation of each subprocess.

Throughout the TW 05 experiment, planning cell members were surveyed to determine the knowledge incorporated in a particular phase of planning. To determine the

[35] L. Zimmer. Telephone conversation with Linda Zimmer on 25 January 2006.

[36] A. Blocksidge. Email with Andrew Blocksidge, 30 January 2006.

knowledge inherent in a particular planning phase action, the staff members were asked questions regarding how long they required to learn how to produce the outputs they generated and how long it would require a "competent" O-5 officer to learn the skills to generate the same output. The staff members were to assume that the officer in question was from their respective service (US Army Lieutenant Colonel, US Air Force Lieutenant Colonel, US Marine Corps Lieutenant Colonel, or US Navy Commander) and was from a line position (infantry, aviator, surface warfare). These responses were determined to be unusable for analysis due to the inherent biases of the staff members. To compensate for these biases, the "Normalized Learning Time" method was used. This method, although it does not utilize real learning times to determine the relative learning times, it does capture the relative learning time for the subprocesses effectively.

In order to determine relative learning times, after completion of the TW 05 scenario select members of the FOPs staff were surveyed as subject matter experts to determine which subprocesses of the planning process required to most knowledge to produce. The staff members were asked, "Given 100 days of training time, how much should be spent by the competent O-5 baseline officer learning each subprocess?" Table 3 presents the results of this survey:

	Intelligence Planner	OPT Leader	Ground Fires Planner	Normalized Learning Time Values Used for KVA Analysis (Average of OPT Leader and Ground Fires Planner)
	Time Spent to Learn Subprocess (days)	Time Spent to Learn Subprocess (days)	Time Spent to Learn Subprocess (days)	Time Spent to Learn Subprocess (days)
Mission Analysis	20	20	10	15
COA Development	15	20	20	20
COA Analysis	30	15	20	17.5
COA Selection	10	10	10	10
ConOps Development	15	30	30	30
ConOps Approval	10	5	10	7.5

Table 3. Normalized Learning Time Survey Results

A statistical analysis of the Normalized Learning Times as determined by the three members of the FOPs staff found that a 79.3% correlation exists between the Normalized

Learning Times offered by the OPT Leader and the Ground Fires Planner. This high correlation lends credibility to these survey results and, thus the average of these two serves as the Normalized Learning Times for the subprocesses for this analysis.

To attribute revenue to the subprocesses of the overall process, the relative amount of the knowledge applied to create the process output by each subprocess must be determined. To estimate the knowledge added by a subprocess, the Normalized Learning Times presented in the table above is multiplied by the number of actors that are interacting with the subprocess input to generate the subprocess output. For example, Mission Analysis has a Normalized Learning Time of 15 days and the subprocess is conducted by two staff members (FOPs Ground Planner and FOPs Intel Planner). Therefore, the knowledge added in the subprocess is 30 days. This method of determining knowledge added by each subprocess is conducted for each subprocess and the results added to determine the total knowledge added throughout the overall planning process. Following the determination of knowledge value added in the overall planning process the relative knowledge value added by each subprocess relative to the overall process is determined as a percentage. This relative knowledge value added (as a percentage of the total process knowledge) is then multiplied by the market comparable value of the overall process output to determine the value of each subprocess.

Table 4 shows the calculations for the value attributed to each subprocess and the overall planning process:

Process	Actors	Knowledge (Normalized Learning Time)	Total Knowledge For Subprocess	% of Total Knowledge	Value Attributed to Process
Mission Analysis			30	5.85%	$1,682.93
	Ground Planner	15			
	Intel Planner	15			
COA Development			120	23.41%	$6,731.71
	OPT Leader	20			
	IO Planner	20			
	SOF Planner	20			
	MEU XO	20			
	MEU Planner (S-2A)	20			
	MEU Planner (S-6A)	20			
COA Analysis			157.5	30.73%	$8,835.37
	OPT Leader	17.5			
	Intel Planner	17.5			
	Ground Planner	17.5			
	Ground Fires Planner	17.5			
	IO Planner	17.5			
	SOF Planner	17.5			
	CFMCC Fires Planner	17.5			
	MEU XO	17.5			
	ESG Planner	17.5			
COA Selection			70	13.66%	$3,926.83
	CFMCC	10			
	CFMCC OpsO	10			
	MEU XO	10			
	ESG Commander	10			
	FOPs O	10			
	OPT Leader	10			
	CFMCC Fires Planner	10			
ConOps Development			90	17.56%	$5,048.78
	MEU XO	30			
	MEU Planner (S-2A)	30			
	MEU Planner (S-6A)	30			
ConOps Approval			45	8.78%	$2,524.39
	CFMCC	7.5			
	CFMCC OpsO	7.5			
	MEU XO	7.5			
	ESG Commander	7.5			
	FOPs O	7.5			
	OPT Leader	7.5			
Total for Planning Process		512.5	512.5	100.00%	$28,750.00

Table 4. Value Attributed to “As-Is” Subprocesses and Planning Process

2. Determining Process and Subprocess Costs

Table 5 demonstrates the time required to complete the phases of the planning process for the development of this ConOps:

Process	Actors	Cost per manhour	Touch Time (Hours)	Total Manpower Cost	% of Total Actual Cost
Mission Analysis				$961.74	24.62%
	Ground Planner	$44.62	4	$178.47	
	Intel Analyst	$48.95	16	$783.27	
COA Development				$1,159.22	29.67%
	OPT Leader	$48.95	1	$48.95	
	IO Planner	$51.13	4	$204.51	
	SOF Planner	$38.94	4	$155.78	
	MEU XO	$56.28	6	$337.68	
	MEU Planner (S-2A)	$37.46	6	$224.73	
	MEU Planner (S-6A)	$31.26	6	$187.57	
COA Analysis				$584.92	14.97%
	OPT Leader	$48.95	1.42	$69.52	
	Intel Analyst	$48.95	1.42	$69.52	
	Ground Planner	$44.62	1.42	$63.36	
	Ground Fires Planner	$41.29	1.42	$58.63	
	IO Planner	$51.13	1.42	$72.60	
	SOF Planner	$38.94	1.42	$55.30	
	CFMCC Fires Planner	$43.98	1.42	$62.46	
	MEU XO	$56.28	1.42	$79.92	
	ESG Planner	$43.98	1.42	$53.63	
COA Selection				$232.45	5.95%
	CFMCC	$69.15	0.6	$41.49	
	CFMCC OpsO	$59.50	0.6	$35.70	
	MEU XO	$56.28	0.6	$33.77	
	ESG Commander	$59.50	0.6	$35.70	
	FOPs O	$50.05	0.6	$30.03	
	OPT Leader	$48.95	0.6	$29.37	
	CFMCC Fires Planner	$43.98	0.6	$26.39	
ConOps Development				$624.98	16.00%
	MEU XO	$56.28	5	$281.40	
	MEU Planner (S-2A)	$37.46	5	$187.28	
	MEU Planner (S-6A)	$31.26	5	$156.31	
ConOps Approval				$343.43	8.79%
	CFMCC	$69.15	1	$69.15	
	CFMCC OpsO	$59.50	1	$59.50	
	MEU XO	$56.28	1	$56.28	
	ESG Commander	$59.50	1	$59.50	
	FOPs O	$50.05	1	$50.05	
	OPT Leader	$48.95	1	$48.95	
Total for Planning Process Iteration			44.2	$2,055.78	100.00%

Table 5. Manpower Costs of “As-Is” Subprocesses and Planning Process

3. Determining the ROI for the Process and Subprocesses

The resulting analysis provided the following insights into the ROI of the human knowledge that was required to develop the approved ConOps during TW 05:

Process	Knowledge (K) (% of total)	Value Produced By Process (V)	Manpower Cost of Process (C)	ROI ([V-C]/C x 100%)
Mission Analysis	5.85	$1682.93	$961.74	74.99%
COA Development	23.41	$6,731.71	$1,159.22	480.71%
COA Analysis	30.73	$8,835.37	$584.92	1410.52%
COA Approval	13.66	$3926.83	$232.45	1589.33%
ConOps Development	17.56	$5,048.78	$624.98	707.83%
ConOps Approval	8.78	$2,524.39	$343.43	635.05%
Planning Process Total	100	$28,750.00	$3,906.75	635.91%

Table 6. ROI of “As-Is” Subprocesses and the Planning Process

E. “TO-BE” PLANNING PROCESS

This scenario describes the JFMCC Planning Process aided with the developmental IT presented in Chapter II. The IT systems noted (CoRaven, Weasel, and Fox) are systems that were under development for the US Army Research Laboratory, and thus were focused on military planning in a land warfare environment. In this scenario, it is assumed that the systems developed are capable of modification to aid in the planning of a naval forces scenario.

1. The Cost of IT

The estimated cost of the CoRaven, Weasel, Fox suite of decision support tools is not readily available for this research for various reasons. Key among these is the fact that the funding for the suite of tools was provided by the Army Research Laboratory to multiple organizations, particularly academic institutions. At these institutions, the students who did much of the programming did not receive direct compensation for the work involved with

development of the systems and, therefore, did not maintain records of work consistently. Therefore, for this research an estimated per unit price is derived from commercial products that incorporate similar technologies. For the CoRaven, Weasel, and Fox systems, the highest purchase prices of a comparable commercial product will be used to provide the most conservative calculations in the KVA analysis of the notional process.

The fundamental logic underlying the CoRaven systems programming is Bayesian Networks. Three commercially available software tools were identified as decision support tools that use Bayesian Networks as their foundation. These three programs are Bayesia Lab Version 4.0[37], Hugin Explorer[38], and Agena Risk[39]. The purchase prices of these products vary greatly, at $51,210.70, $4,336.65 and $1,895.09. For this research the highest purchase price of $51,210.70 will serve as the estimated purchase price for the CoRaven tool. Assuming a product lifespan of five years, this calculates to a per year cost of $10,242.14. For this research, it is assumed that the naval command using the tool will deploy for six months every year, thus a weekly ownership cost of $393.93 is estimated. Based upon the Trident Warrior experiment, it is assumed that the planning staff will generate one plan a week.

The fundamental logics underlying the Weasel and Fox systems are genetic algorithm and combinations and permutations of the capabilities and rules selected by the human operator. A survey of commercially available DSSs was conducted and three tools were identified as having similar logic: AI Trilogy ($1,245.00)[40], Palisade Risk Optimizer

37 BayesiaLab Version 4.0 is a product developed by Bayesia SA of Laval Cedex, France. The purchase price of BayesiaLab v. 4.0 Professional Edition with Technical Support was used for determining purchase cost of the software. The purchase price of 39,600 Euros was converted to US Dollars using a conversion rate of 1.29319 US Dollars per Euro. Further information regarding the BayesiaLab product and Bayesia S/A is available at http://www.bayesia.com. Retrieved May 2006.

38 Hugin Explorer is a product developed by Hugin Expert A/S of Aalborg, Denmark. The purchase price of 24,995 Danish Krones was converted to US Dollars using a conversion rate of 5.7637 Danish Krones to US Dollar. Further information regarding the Hugin Explorer and Hugin Expect S/A is available at http://www.hugin.com/. Retrieved May 2006.

39 Agena Risk is a product developed by Agena Limited of London, United Kingdom. The purchase price of 1000 British Pounds was converted to US Dollars using a conversion rate of 1.895.09 US Dollars to British Pound. Further information regarding the Agena Risk product and Agena Limited is available at http://www.agena.co.uk. Retrieved May 2006.

40 AI Trilogy is a product developed by Ward Systems Group, Inc. of Frederick, MD. Further information regarding AI Trilogy and Ward Systems Group, Inc is available http://www.wardsystems.com. Retrieved May 2006.

Industrial Version ($1,195.00)[41], and Discipulus Professional Edition ($495)[42]. The highest purchase price of $1,245.00 is estimated as the purchase price for both the Weasel and Fox systems. Assuming a five year lifespan of the tool and the above stated deployment cycle, the weekly ownership cost of the decision support tools is calculated as $9.58 per tool.

2. The Reengineered Planning Process

The primary change from the "as-is" current planning process to the "to-be" planning process is the introduction of the CoRaven, Weasel, and Fox suite of decision support tools. The introduction of these systems will significantly affect the Mission Analysis, COA Development, and COA Comparison subprocesses.

During the Mission Analysis subprocess, the Intelligence Analyst dedicated the bulk of the time finding, collecting, and preparing for presentation information regarding the enemy forces and the surrounding battlespace. With the addition of the CoRaven and Weasel systems as an aid to the Mission Analysis process, the Intelligence Analyst will input the decision making logic, in the form of a logic tree during predeployment periods or during periods of calm. The CoRaven system will generate probabilities of likely enemy actions and automatically transfer data to the Weasel system for enemy COA generation. With the enemy data transferred to the Weasel system, the Intelligence Analyst would select basic assumptions through the graphical interface. Then the Weasel system will generate the set of potential enemy COAs. From this set of enemy COAs the Intelligence Analyst will select those which he determines to be the most relevant to the situation by which friendly COAs will be compared. For this research it is assumed that the time required to execute the Mission Analysis tasks performed by the Intelligence Analyst will be 25% of that currently required in the planning process. It is also assumed that 50% of the knowledge required by the Intelligence Analyst to complete the Mission Analysis tasks will be resident in the IT systems.

With the implementation of the DSS Suite, the human labor required to develop and compare potential friendly COAs against the expected enemy COAs will be significantly

[41] Risk Optimizer is an add-in developed for use with the Microsoft Excel program by the Palisades Corporation of Ithaca, NY. Futher information regarding Risk Optimizer and the Palisades Corporation is available at http://www.palisade.com. Retrieved May 2006.

[42] Discipulus is a product developed by Register Machine Learning Technologies, Incorporated of Littleton, CO. Further information regarding the Discipulus product and RML Technologies, Inc. is available at http://www.aimlearning.com. Retrieved May 2006.

reduced. The potential enemy COAs deemed most significant to the commander and the planning staff (during the Mission Analysis subprocess) will be transferred automatically from the Weasel system to the Fox system. The Fox system will then generate the potential friendly COAs for the staff based on inputted data (such as organization, terrain constraints, stated constraints and restraints, etc.) and will also run the combat simulator to determine the fitness of each COA against the set of potential enemy COAs. With the implementation of the Fox system, the two distinct subprocesses of COA Development and COA Analysis will be combined into a single subprocess. It is assumed that the COA Development/Analysis process aided by the Fox DSS will require one hour. It is also assumed that 75% of the knowledge required to accomplish the current COA Development and COA Analysis tasks will be resident in the Fox DSS.

Based upon the SME opinion, anecdotal information claims that the quality of the products produced with the aid of the CoRaven, Weasel and Fox systems are at least as good as those produced without the systems. However, since the information does not provide conclusive evidence it is assumed for this research that the value of the process output for the "to-be" reengineered process is the same as that of the "as-is" process.[43]

F. KVA ANALYSIS OF THE "TO-BE" PROCESS

The following KVA analysis is provided to determine the change in the ROI of the planning process and the subprocesses with the introduction of the DSS suite to aid the process. The analysis will also provide a ROI for the information technology based upon the estimates and assumptions presented above.

1. Determining the Value of the "To-Be" Process IT

To determine the value of the decision support tools provided by the notional IT, the value of subprocess outputs and the planning process output are assumed to be unchanged from the current process. The value of the output of the "to-be" COA Development/Analysis subprocess is assumed to be the sum of the values of the current COA Development and COA Analysis subprocesses. Table 7 demonstrates the value which is attributed to the human actors and the decision support tools in the "to-be" subprocesses

[43] Per phone conversation with Professor Caroline Hayes at the University of Minnesota on 26 April 2006.

affected by the introduction of the DSS suite. All other subprocess are assumed to be unaffected by the DSS suite and therefore are excluded from Table 7.

Process	Actor/Asset	Total Knowledge For Subprocess (Learning Time)	% of Subprocess Knowledge Attributed to Process Asset	% of Total Process Knowledge	Value Attributed to Subprocess and Actor/Asset
Mission Analysis		30		5.85%	$1,682.93
	Human Actors	22.5	75%	4.39%	$1,262.20
	CoRaven/ Weasel tools	7.5	25%	1.46%	$420.73
COA Development/Analysis		227.5		54.15%	$15,567.07
	Human Actors	69.4	25%	13.54%	$3,891.77
	Fox tool	208.1	75%	40.61%	$11,675.30

Table 7. Value Attributed to IT in "To-Be" Process

2. Determining "To-Be" Process and Subprocess Costs

Table 8 demonstrates the costs of the human actors and IT associated with the "to-be" planning process.

Process	Actors	Cost per manhour	Touch Time (Hours)	Total Manpower Cost	IT Cost (Weekly Cost)	Total Cost	% of Total Actual Cost
Mission Analysis				$374.29	$403.51	$777.79	31.50%
	Ground Planner	$44.62	4	$178.47			
	Intel Analyst	$48.95	4	$195.82			
COA Development/ Analysis				$480.63	$9.58	$490.21	19.86%
	OPT Leader	$48.95	1	$48.95			
	Intel Analyst	$48.95	1	$48.95			
	IO Planner	$51.13	1	$51.13			
	SOF Planner	$38.94	1	$38.94			
	Ground Planner	$44.62	1	$44.62			
	MEU XO	$56.28	1	$56.28			
	MEU Planner (S-2A)	$37.46	1	$37.46			
	MEU Planner (S-6A)	$31.26	1	$31.26			
	Ground Fires Planner	$41.29	1	$41.29			
	CFMCC Fires Planner	$43.98	1	$43.98			
	ESG Planner	$37.76	1	$37.76			
COA Selection				$232.45		$232.45	9.42%
	CFMCC	$69.15	0.6	$41.49			
	CFMCC OpsO	$59.50	0.6	$35.70			
	MEU XO	$56.28	0.6	$33.77			
	ESG Commander	$59.50	0.6	$35.70			
	FOPs O	$50.05	0.6	$30.03			
	OPT Leader	$48.95	0.6	$29.37			
	CFMCC Fires Planner	$43.98	0.6	$26.39			
ConOps Development				$624.98		$624.98	25.31%
	MEU XO	$56.28	5	$281.40			
	MEU Planner (S-2A)	$37.46	5	$187.28			
	MEU Planner (S-6A)	$31.26	5	$156.31			
ConOps Approval				$343.43		$343.43	13.91%
	CFMCC	$69.15	1	$69.15			
	CFMCC OpsO	$59.50	1	$59.50			
	MEU XO	$56.28	1	$56.28			
	ESG Commander	$59.50	1	$59.50			
	FOPs O	$50.05	1	$50.05			
	OPT Leader	$48.95	1	$48.95			
Total for Planning Process Iteration			44.2	$2,055.78	$413.08	$2,468.87	100.00%

Table 8. Manpower and IT Costs Associated with "To-Be" Planning Process

3. Determining ROI for "To-Be" Process and Subprocess

Table 9 presents the ROI of the "to-be" planning process and subprocesses.

Process	Knowledge (K) (% of total)	Value Attributed to Process (V)	Costs Associated to Process (C)	ROI ([V-C]/C x 100%)
Mission Analysis	5.85	$1,682.93	$777.79	116.37%
COA Development/ Analysis	54.15	$15,567.07	$490.21	3075.59%
COA Approval	13.66	$3,926.83	$232.45	1589.33%
ConOps Development	17.56	$5,048.78	$624.98	707.83%
ConOps Approval	8.78	$2,524.39	$343.43	635.05%
Planning Process Total	100.00	$28,750	$2,468.87	1064.5%

Table 9. ROI of "To-Be" Process and Subprocesses

4. Determining ROI of Information Technology

To determine the ROI for the notional DSS suite, the value (see Table 7) and costs (see Table 8) associated with the decision support tools from the above analysis are used in the traditional ROI formula. The total revenue attributed to the DSS suite is $12,096.03. The total cost associated with the DSS suite is $413.08.

$$\frac{(\$12,096.03 - \$413.08)}{\$413.08} \times 100\% = 2828.25\%$$

This calculated ROI states that for every $1 invested in the acquisition of the notional DSS suite, $28.28 are returned.

G. COMPARISION OF THE "AS-IS" AND "TO-BE" PROCESSES

The following figures and tables demonstrate the resulting changes in execution time, the change in cost, and the change in the ROI associated with the introduction of the notional DSS suite to the JFMCC Planning Process. Figure 7 compares the execution time required for the "as-is" and "to-be" planning processes.

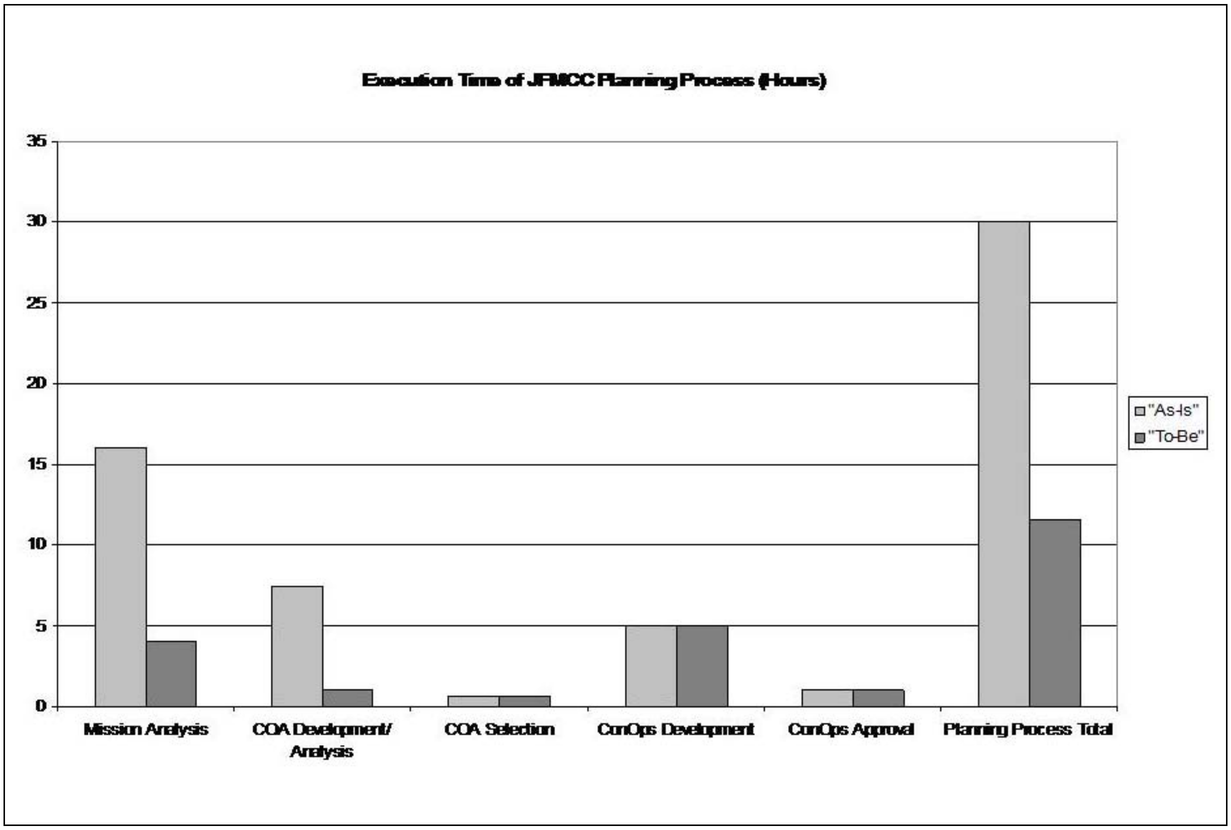

Figure 7. Execution Time Comparison of "As-Is" and "To-Be" Process[44]

With the introduction of the automated systems, the time required to execute the Mission Analysis and COA Development and Analysis are reduced to 25% and 13.5% of the "as-is" subprocesses. In the notional "to-be" process, execution time is reduced to 38.6% of the current requirement.

[44] Execution time is determined as the maximum "touch time" required for a subprocess. The execution time for the "as-is" COA Development/Analysis is the sum of the time required of the two distinct subprocesses of "COA Development" and "COA Analysis."

Figure 8 shows graphically the cost differences between the "as-is" planning process and the "to-be" planning process.

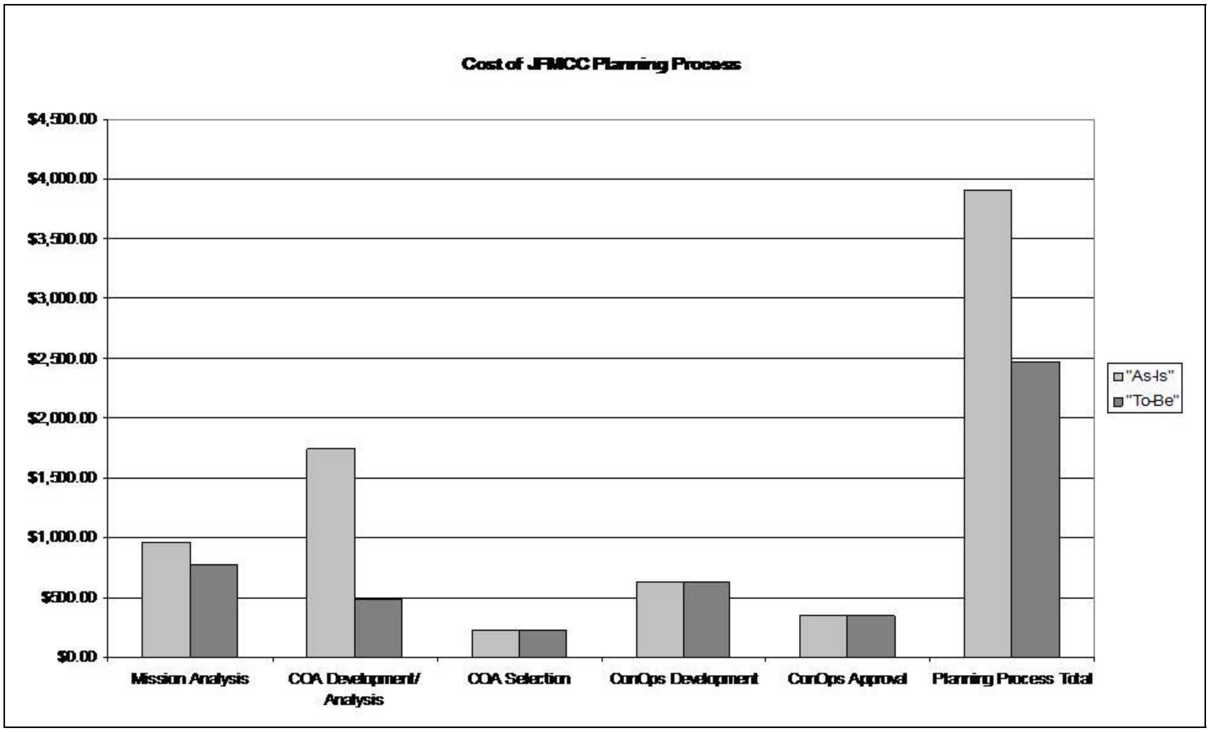

Figure 8. Cost Comparison of the "As-Is" and "To-Be" Process[45]

In the "to-be" JFMCC Planning Process the cost associated with Mission Analysis is reduced to 80% of the "as-is" subprocess, COA Development/Analysis costs are reduced to 28% of the current subprocess, and the entire planning process costs are reduced to 63% of the "as-is" process.

[45] Costs associated with the "as-is" COA Development/Analysis is the sum of the two distinct subprocesses of the "as-is" planning process. Costs of the "to-be" process include both manpower and IT costs.

Figure 9 demonstrates the affects of the introduction on the notional DSS and process reengineering on the ROI values of the subprocesses and the planning process.

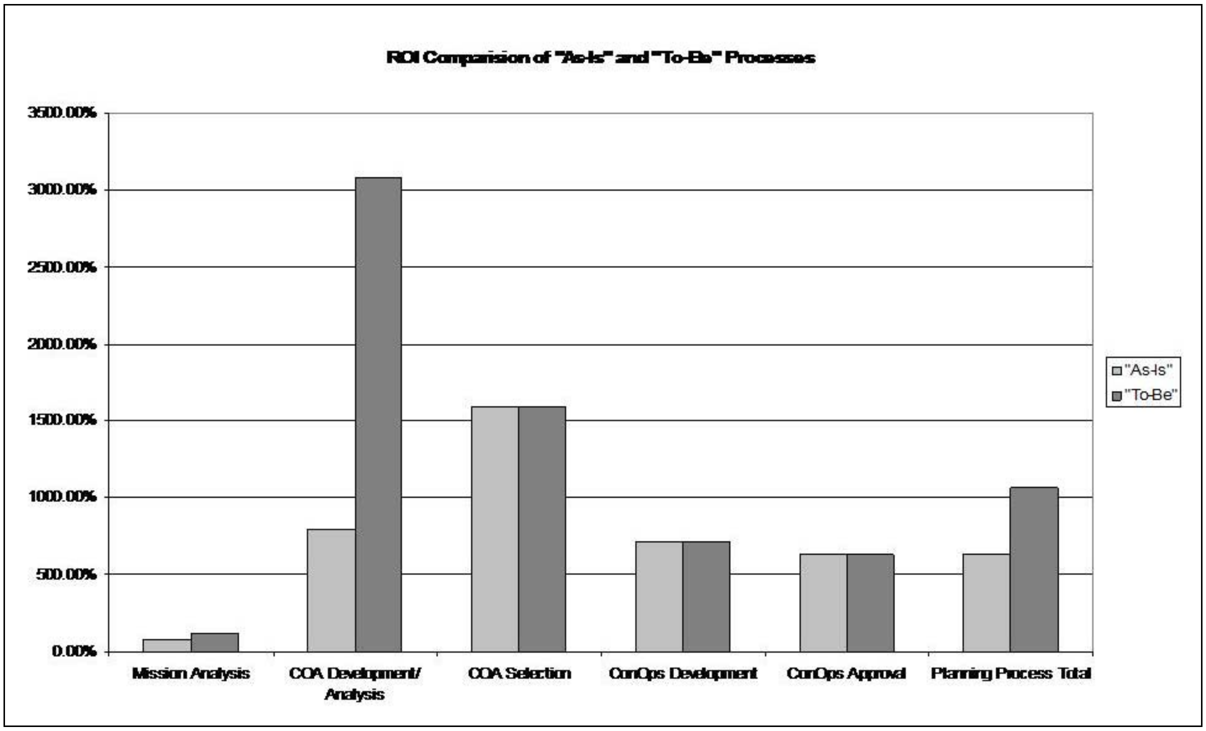

Figure 9. ROI Comparison of the “As-Is” and “To-Be” Planning Process

With the introduction of the decision support tools to the JFMCC Planning Process, the ROI values of the Mission Analysis and COA Development/Analysis 41% and 2283%, respectively. The overall process ROI is improved by 429%.

V. CONCLUSIONS AND RECOMMENDATIONS

A. RESEARCH LIMITATIONS

This Proof of Concept was generated using subject matter expert input and observations from one execution of the JFMCC Planning Process during TW 05 experiment. Therefore, the data presented in this research can not be assumed to be accurate for all possible scenarios. Additionally, given exercise restrictions, entire staff planners from the IWO JIMA Strike Group and the 24th Marine Expeditionary Unit were not available; therefore the calculations presented were based solely on available data with the limited staffs participating in TW 05. The JFMCC Planning Process, as prescribed in NWDC TACMEMO 3-32-03, was recently adopted by the Second Fleet staff prior to the TW 05 experiment. Therefore, procedures and policies relating to the planning process may have been evolving during execution. More accurate calculations could be made of the planning process through observation in actual operations during a deployment period.

Likewise, the CoRaven, Weasel, and Fox DSS tools were developed for use in a ground conflict scenario, with opposing armies battling using conventional tactics. The tools do not currently have function in naval warfare environments, nor do they possess the capability to look at potential COAs that include non-kinetic warfare or asymmetric threats. The systems are introduced to illustrate the potential of IT to support the planning process. The cost associated with this IT is an estimate, based upon a survey of currently available commercial products. This survey of commercial products identified products with similar underlying logics, not necessarily similar functionality. A custom DSS suite developed specifically for the Department of the Navy may cost considerably more or less.

B. RESEARCH QUESTIONS

The KVA Analysis of the current JFMCC Planning Process reveals that the process inefficiencies are most significant in the Mission Analysis and COA Development subprocesses. These subprocesses therefore represent the facets of the planning process with the greatest potential for improvement through the application of IT systems. Decision support tools of similar capability as the CoRaven, Weasel, and Fox systems will likely

provide significant improvement to the planning process through automation of portions of these subprocesses. The improvements to the process through automation will be most readily quantified in terms of improvement in planning time requirements, cost savings, and improved efficiency as measured in terms of ROI.

1. Planning Time

Among the key capabilities required for the implementation of the FORCEnet Functional Concept is to provide decision makers the ability to make and implement good decisions quickly. Through the adoption of IT, such as the DSSs identified in this research, the time required to plan military operations would be decreased by 61.4%. While this improvement is specific to the planning of an operation, the residual effects would allow for execution of the assigned mission more quickly.

2. Cost Savings

The manpower cost associated with planning present the most quantifiable advantage of the adoption of IT systems to support the JFMCC Planning Process. With the implementation of the DSSs presented in this research, it is projected that the over-all cost of generating the plan would decrease by 37% to include the cost associated with the IT systems.

3. Improved ROI

The ROI of the overall JFMCC Planning Process was markedly improved from the current process to the "to-be" process. With the introduction of the notional DSS suite to aid the planning process, an ROI improvement for the overall process of 429% is projected.

C. RECOMMENDATIONS TO THE US NAVY

The JFMCC Planning Process was only recently formalized with the publication of NWDC TACMEMO 3-32-03 and the implementation on the operational Navy Fleet continues. The JFMCC Planning Process, as executed during Trident Warrior 05, does not take advantage of IT as a tool to improve the process or the product of the planning. The leadership of the US Navy must take the initiative to bring IT capabilities to this most critical of decision-making functions for the FORCEnet Functional Concept to be realized.

Through the development and adoption of DSSs to aid the planning process, with similar capabilities to those provided by the CoRaven, Weasel, and Fox systems, the effects

of the process improvement will be significant. Through the decreased labor required in plan generation, the human actors currently employed in lower-level command and control functions will be able to dedicate themselves to higher-level functions that require more judgment and insight that only the human can provide. Likewise, the ability of a planning staff to generate a plan in a timelier manner will allow for the execution of the operations at a faster tempo. This will leave the enemy unbalanced and in a reactionary mode to US actions.

Investment in IT systems, just as any other investment, always carries inherent risk. The costs of such systems will be significant during development and implementation while the returns of the investment will be only realized over the life of the system. Using the KVA methodology, decision makers are able to gain insight into organizational performance efficiencies and inefficiencies. Using the analysis methodology to evaluate prospective investments, the decision makers are equipped with risk data and the potential value of these systems to aid in investment decisions.

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